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The intersecting system of patients with chronic pain and their family caregivers

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Chapter 3

Caregivers' attentional bias to pain: does it affect caregiver accuracy in detecting patient pain behaviors?

Somayyeh Mohammadi, Mohsen Dehghani, Ali Khatibi, Robbert Sanderman, Mariët Hagedoorn. (2015). PAIN, 156 (1), 123-130

Abstract

Attentional bias to pain among family caregivers of patients with pain may enhance the detection of pain behaviors in patients. However, both relatively high and low levels of attentional bias may increase disagreement between patients and caregivers in reporting pain behaviors. This study aims to provide further evidence for the presence of attentional bias to pain among family caregivers, to examine the association between caregivers' attentional bias to pain and detecting pain behaviors, and test whether caregivers' attentional bias to pain is curvilinearly related to patient and caregiver disagreement in reporting pain behaviors. The sample consisted of 96 caregivers, 94 patients with chronic pain, and 42 control participants. Caregivers and controls completed a dot-probe task assessing attention to painful and happy stimuli. Both patients and caregivers completed a checklist assessing patients' pain behavior. Although caregivers did not respond faster to pain congruent than pain incongruent trials, caregiver responses were slower in pain incongruent trials compared with happy incongruent trials. Caregivers showed more bias toward pain faces than happy faces, whereas control participants showed more bias toward happy faces than pain faces. Importantly, caregivers' attentional bias to pain was significantly positively associated with reporting pain behaviors in patients above and beyond pain severity. It is reassuring that attentional bias to pain was not related to disagreement between patients and caregivers in reporting pain behaviors. In other words, attentional bias does not seem to cause overestimation of pain signals.

Keywords: Attentional bias, Family caregivers, Chronic pain patients, Pain behaviors

Introduction

Patients in pain may show pain behaviors, such as body gestures and facial expressions (Badr & Milbury, 2011). The ability to detect such pain cues is of crucial importance for informal caregivers, because failure to do so may prevent them from providing adequate support (Boerner, Chambers, Craig, Pillai Riddell, & Parker, 2013). Although pain cues capture the attention of others (Goubert, Vervoort, & Crombez, 2009; A. C. d. C. Williams, 2002), observers are not always accurate in detecting pain behaviors (Boerner et al., 2013; Cano, Johansen, & Geisser, 2004; Cano, Johansen, & Franz, 2005). However, little is known about factors that may influence the detection of pain behavior in others.

One important factor in pain detection is attentional bias (MacLeod, Mathews, & Tata, 1986; J. M. Williams, Mathews, & MacLeod, 1996), that is, the implicit inclination to attend to pain stimuli while ignoring other stimuli (Crombez, Van Ryckeghem, Eccleston, & Van Damme, 2013). Attentional processes in patients have been recognized as important in the perception of pain and pain-related behaviors (Eccleston & Crombez, 1999; McGowan, Sharpe, Refshauge, & Nicholas, 2009). Underlying processes may be sensitivity to pain cues (Kirwilliam & Derbyshire, 2008) and disability to disengage from such cues (Van Damme, Crombez, & Eccleston, 2004). Similarly, caregivers with higher attentional bias may be more sensitive to their patients' pain cues (i.e., pain behaviors) and have more difficulty to disengage from these cues and, therefore, report more pain cues compared to caregivers with lower attentional bias.

Previous research has demonstrated the existence of attentional bias toward pain in patients (Dehghani, Sharpe, & Nicholas, 2003; Haggman, Sharpe, Nicholas, & Refshauge, 2010; Khatibi, Dehghani, Sharpe, Asmundson, & Pouretmad, 2009; Liossi, Schoth, Bradley, & Mogg, 2009), and sometimes in family members or caregivers of individuals in pain (e.g., Mohammadi et al., 2012; Vervoort et al., 2011). Attentional bias may develop in caregivers owing to their caregiving experiences. This study aims to replicate earlier findings regarding the existence of bias in caregivers, and to examine whether caregivers who show more bias also report more pain behavior in patients than do caregivers who show less bias toward pain.

Although attentional bias toward pain may help the detection of pain behavior, there also may be detrimental effects. Caregivers who score high on attentional bias may be so focused on pain cues that they interpret even ambiguous cues as signs of pain (Liossi, White, Croome, & Hatira, 2012). Furthermore, caregivers with relatively low attention to pain may fail to detect pain cues accurately. Both conditions may lead to differences between caregivers' and patients' estimations of pain cues (e.g., Liossi et al., 2012; Mohammadi et al., 2012), which can cause psychological and health-related problems for patients (Cremeans-Smith et al., 2003; Riemsma, Taal, & Rasker, 2000). For example, illness underestimation by caregivers can express itself in less support, and can suggest to the patient that the illness was not taken seriously (Riemsma et al., 2000). In contrast, overestimation of illness may be related to caregivers' overprotection, which may also decrease patients' well-being (Holmbeck et al., 2002; Power, Dahlquist, Thompson, & Warren, 2003). The present study

investigates the association between caregivers' attentional bias toward pain and patients' and caregivers' agreement about pain behaviors.

In sum, this study tests four hypotheses:

1. Caregivers show more attentional bias toward pain compared to control participants;
2. Caregivers show more attentional bias toward pain than toward happy stimuli compared to control participants;
3. Caregivers who score high on attentional bias toward pain report higher levels of pain behavior in patients than caregivers who score low on attentional bias;
4. Relatively high and low levels of attentional bias toward pain in caregivers are associated with less agreement between reports of patients' pain behavior within patient-caregiver dyads (i.e., a curvilinear association).

Method

Procedure

The data are part of a larger study examining interpersonal interactions between patients with chronic pain and their family caregivers. Data collection took place at Atieh Hospital, Tehran, Iran. The mental health center of the hospital provided ethical approval for the study. Three groups of participants were included in this study: patients with musculoskeletal chronic pain and their family caregivers, and control participants. For practical reasons, data were collected from September 2012 until the end of January 2013. We invited all eligible patients and caregivers during this period; no data analyses were performed until the end of data collection. To determine the sample size in the control group, we followed other studies that examined attentional bias to pain information among patients with pain and control participants (e.g., Asmundson, Carleton, & Ekong, 2005; Dear, Sharpe, Nicholas, & Refshauge, 2011; Haggman et al., 2010; Khatibi et al., 2009).

Patients and family caregivers were approached when visiting the hospital for an appointment with an orthopedist. The secretaries of an Orthopedic Clinic identified approximately 150 potentially eligible patients and caregivers as soon as they registered at the secretary desk. The researcher next provided a short description of the study and evaluated the inclusion and exclusion criteria, and invited the eligible participants to take part in the study. One hundred twenty-eight patients and caregivers agreed to participate in the study. The main reasons for not participating were having severe pain that interferes with the patient performance, being worried about not having sufficient time to complete the study and not being interested in participating. After patients and their caregivers announced their agreement, the researcher asked secretaries to inform the researcher about the remaining time to the patients' appointment. When there was not enough time for caregivers to participate in both parts of the study (i.e., dot-probe task and questionnaire parts), they were only asked to

complete the questionnaires and not the dot-probe task. Therefore, only 96 caregivers were asked to complete the dot-probe task as well as filling out the questionnaires. In addition, the patients of these caregivers also completed the questionnaires. Figure 1 shows the flow of participants in this study. Inclusion criteria for both patients and caregivers were: being older than 18 years; having sufficient literacy to complete questionnaires; being able to use both hands for completing a pictorial dot-probe task; and having enough time for participation while waiting for the patients' medical consultation. Furthermore, caregivers had to have lived with the patient who suffered from continuous pain for more than 3 months. An exclusion criterion for caregivers was having constant pain for more than 3 months themselves. Other exclusion criteria for both patients and caregivers were having a serious mental illness, head injury, and current drug and alcohol abuse. Patients and their caregivers provided informed consent.

A convenience sample of 42 non-caregiving individuals who were approached by the researcher at the same hospital was asked to complete the dot-probe task. Control participants were individuals who did not have pain problems themselves and reported no pain problems in their first-degree relatives. The main reasons for visiting the hospital were having an appointment for an annual health checkup, or having a referral to the skin and hair, or nutrition clinic. Some of the control participants did not have a personal appointment, but were accompanying friends or relatives who had an appointment with a specialist in one of the above-mentioned clinics. All inclusion and exclusion criteria that were applied for caregivers were also used for the control group (i.e., except for living with a patients with chronic pain). All eligible individuals who were approached by the researcher agreed to participate.

Individuals who agreed to participate were guided to the research room where they were asked to conduct the pictorial dot-probe task and, after a short rest, they were requested to fill in questionnaires. At the end of the two parts of the study, more information about the purpose of the study was given. On request, participants received some information about the interpretation of their results of the dot-probe task.

Measures

This study used data from the pictorial dot-probe task (applied to assess attentional bias) of caregivers and controls to test hypotheses 1 and 2. To test hypotheses 3 and 4, the study used the measure of caregivers' attentional bias and questionnaire measures of caregivers and patients' estimations of pain behavior in patients. In addition, patients were asked to provide information about pain severity and pain-related disability.

Pictorial Dot-Probe Task. The pictorial dot-probe task is a spatially oriented motivated attention task that is administered through computer to capture attentional bias toward a specific stimulus (Koster, Crombez, Verschuere, & De Houwer, 2004; MacLeod et al., 1986). In this study, the stimuli were the faces of five men and five women displaying three expressions (pain, happy, and neutral faces). The pictures have previously been validated by Roy and colleagues (Roy et al., 2007). We used Affect 4.0 (Leuven, Belgium),

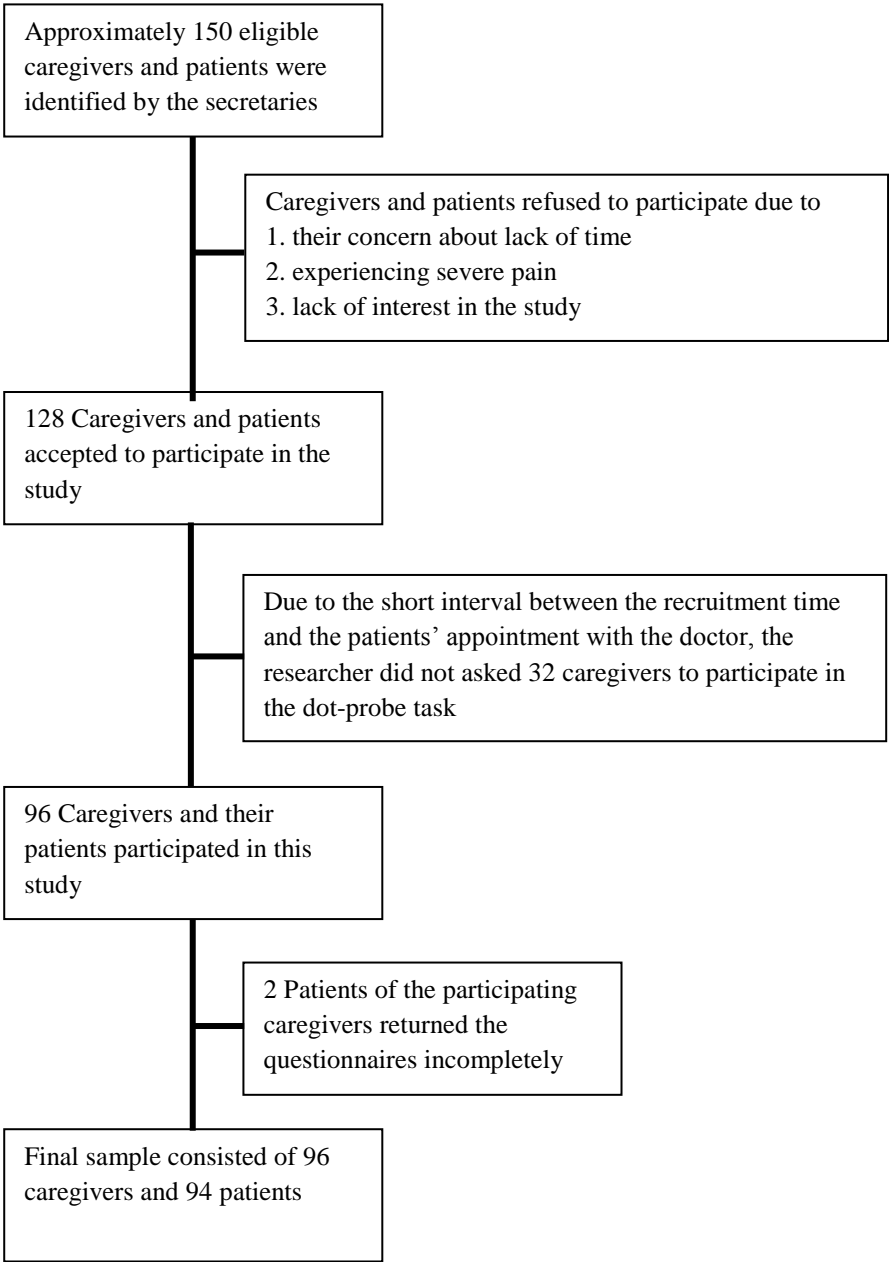


Figure 1. The flow diagram of the participants’ recruitment

which is free psychological software that was designed for psychological experiments (see Spruyt, Clarysse, Vansteenwegen, Baeyens, & Hermans, 2010) for the full features of this software; see <http://fac.ppw.kuleuven.be/clep/affect4>).

All the stimuli were presented on a laptop monitor (15.6 inches). A fixation point (+) was presented at the center of the monitor for 500 ms. After the fixation point was removed, a pair of faces appeared on the screen, one above the fixation point and the other below the point. At each presentation, one of the faces showed a painful or happy expression and the other face showed the same person with a neutral expression. The faces remained for 500 ms and were then replaced by a fixation point. When the fixation point disappeared, a probe (●) was presented in the same spatial location of either the experimental or neutral face. Participants were asked to press the “Right Ctrl” key when they saw a probe above the fixation point and press “Left Ctrl” when they saw the probe below the fixation point. The

probe disappeared when participants pressed one of the keys, or else automatically after 2000 ms. The test was presented in two separate sessions, including 16 practice trials with neutral pictures (photographs of different landscapes) and 40 experimental trials for painful/neutral and 40 experimental trials for happy/neutral. All the trials (painful/neutral and happy/neutral) were presented randomly in the same block.

The dot-probe task that was used in this study differed from the task that we used in our previous study (please see Mohammadi et al., 2012) in three ways that are worth mentioning. First, this study balanced the gender of the faces presented, whereas the task in the previous study included the faces of 9 men and one woman. Second, this study presented both happy/neutral and pain/neutral trials randomly in the same block, whereas the task in the previous study consisted of two experimental blocks, one for happy/neutral trials and one for pain/neutral trials. Third, the average time for completing the task was considerably reduced in this study (5 instead of 10 minutes) by reducing the number of trials for each stimulus pair from 80 to 40.

After importing output files for all the participants, all the incorrect responses where participants pressed the wrong key were omitted from the database (i.e., 264 trials, 3.4% of the original data). Following the protocol of previous studies (O'Toole, DeCicco, Hong, & Dennis, 2011; Vanneste, Verplaetse, Van Hiel, & Braeckman, 2007), all the reaction times that were 3 SD above or below the mean were considered to be outliers and were deleted from the database (i.e., 136 trials, 1.8% of the data after removing the incorrect trials). For each participant, the mean reaction times were aggregated based on stimuli type (i.e., pain and happy stimuli) and congruency type (i.e., congruent and incongruent). A congruent trial is a trial in which the probe appears at the same location as the target stimulus (i.e., pain or happy picture), and an incongruent trial is a trial in which the probe appears at the same location as the neutral stimulus. This procedure generated a mean reaction time for 1) pain congruent trials, 2) pain incongruent trials, 3) happy congruent trials, and 4) happy incongruent trials. Selective attention is inferred where responding is faster to probes, which appear in the congruent position as compared with the incongruent position. To show the direction of differences between congruent and incongruent trials (Keogh, Thompson, & Hannent, 2003) the pain and happy indices were calculated using the following formula, which has been used in previous studies (e.g., Baum, Huber, Schneider, & Lautenbacher, 2011; Dehghani et al., 2003; Haggman et al., 2010; Keogh et al., 2003; Khatibi et al., 2009; Mohammadi et al., 2012; Vervoort et al., 2011):

$$\text{Attentional bias index} = \text{Mean reaction time of incongruent trials} - \text{Mean reaction time of congruent trials}$$

A positive score indicates a bias toward that stimulus, whereas a negative score indicates a bias away from that stimulus.

Patients' pain behaviors. Pain behaviors were measured with the 17 items Pain Behavior CheckList (PBCL; Kerns et al., 1991). The items were the same for patients and caregiver, however, patients were instructed to report the estimation of their own pain

behaviors and caregivers were asked to report their estimation of the patients' pain behaviors both on a 7-point Likert-type scale (0 = never to 6 = very often). Reliability and stability estimates from several studies of the PBCL support the clinical and theoretical utility of this instrument (Kerns et al., 1991; Osman et al., 1995). In this study, this checklist showed a good internal consistency for caregivers (Cronbach's $\alpha = .88$) and for patients (Cronbach's $\alpha = .84$).

Pain severity. Patients were asked to indicate their current pain on a visual analog scale (VAS) using a 10-cm ungraded horizontal line anchored by two descriptive words at each end, indicating "no pain at all" and "the maximum intensity of pain."

Pain disability. Pain disability was assessed by the Ronald and Morris Disability Questionnaire (RDQ; Roland & Morris, 1983). This questionnaire consists of 24 statements. Patients were requested to report whether each statement applied to them or not. The score can vary from 0 to 24. Higher scores imply a higher disability level. The RDQ was originally developed for patients with back pain. To apply this questionnaire for a heterogeneous group of individuals with chronic musculoskeletal pain, the wording "my back pain" was changed to "my pain" in several studies. The validity of this modified version was satisfactory (Asghari & Nicholas, 2001; Mohammadi et al., 2012). The Cronbach's α of the RDQ in the current sample was .87.

Statistical analyses

Hypotheses 1 and 2. Statistical analyses were performed to examine the reaction times of caregivers and controls in attending to pain and happy stimuli (hypotheses 1 and 2). First, a 2 (Group: Caregiver vs. Control) \times 2 (Stimuli: Pain vs. Happy) \times 2 (Congruency: Congruent vs. Incongruent) analysis of variance (ANOVA) with mean reaction time as dependent variable was conducted to examine the expected differences between caregiver and control participants in attending to pain and happy faces in congruent and incongruent trials. In this analysis group is a between subjects factor and the type of stimuli and congruency are within subject factors.

Next, two separate 2 (Group: Caregiver vs. Control) \times 2 (Congruency: Congruent vs. Incongruent) ANOVAs (and a series of paired sample t-tests) were conducted to further examine the expected differences between caregivers and controls in responding to pain congruent and pain incongruent trials, and in responding to happy congruent and happy incongruent trials.

Two other 2 (Stimuli: Pain vs. Happy) \times 2 (Congruency: Congruent vs. Incongruent) ANOVAs (and a series of paired sample t-tests) were conducted to further examine the differences between attending to pain and happy congruent and to pain and happy incongruent trials, separately for caregivers and controls. Attentional bias indices were calculated to summarize the findings.

Hypothesis 3. Statistical analyses were performed to test whether caregivers who score high on attentional bias toward pain report higher levels of pain behavior of patients than caregivers who score low on attentional bias (hypothesis 3). To examine the associations between caregivers' demographic variables, caregivers' attentional bias to pain (i.e., the pain index), pain behaviors (i.e., based on caregivers' report), and patients' report of pain severity, Pearson product-moment correlations for continuous variables and Spearman q correlations for other variables were conducted. Relevant analyses (i.e., Hierarchical regression analysis or Pearson correlation) were performed to investigate the link between caregivers' attentional bias toward pain and their report of pain behaviors in patients.

Hypothesis 4. Statistical analyses were performed to test whether relatively high and low levels of attentional bias toward pain in caregivers are associated with less agreement between reports of patients' pain behavior within patient-caregiver dyads (hypothesis 4). HLM 7 was used to analyze the level of dyads' agreement on pain behaviors and to examine the link between caregivers' attentional bias toward pain and the dyads' agreement. HLM is the preferred method for evaluating the disagreement between members of a dyad (Maguire, 1999). Several studies (e.g., Cano et al., 2005; Lyons, Jones, Bennett, Hiatt, & Sayer, 2013) have used this method successfully on couples' data. In this method, members of each dyad (i.e., patient and caregiver) are considered as level 1 units nested in dyads that are considered as level 2. The unit of analysis is the dyad, here patient-caregiver dyads, not the members within each dyad.

Before conducting the analysis, to fit a regression line for each dyad, two data points of the outcome variable (i.e., pain behavior) are needed for each member of the dyad. Following the methods described by previous studies (e.g., Cano et al., 2005; Lyons et al., 2013; Raudenbush, Bryk, & Congdon, 2004), two parallel scales were constructed based on items of the Pain Behavior CheckList, separately for patients and caregivers. First the standard deviation of each item was calculated. Then each item was matched with another item with the most similar standard deviation. Since the Pain Behavior CheckList consists of 17 items, the item with the lowest standard deviation was excluded. Finally, one item of each pair was randomly assigned to one of the parallel scales. This procedure resulted in two parallel scales of 8 items for each of the scales. Both parallel scales for caregivers (alphas were .74 and .79) and patients (alphas were .69 and .80) showed acceptable reliability. In addition, to investigate the curvilinear relationship between caregivers' attentional bias to pain and agreement between patients' and caregivers' in reporting pain, a square of attentional bias to pain was calculated (i.e., caregivers' attentional bias to pain \times caregivers' attentional bias to pain). The level 1 (i.e., baseline model) and Level 2 models were calculated. The baseline model was conducted to examine the differences across dyads in mean reporting of pain behaviors and to study the differences between patients' and caregivers' ratings. If the baseline model is significant, the level 2 model can be calculated to determine whether attentional bias to pain is associated with patients' and caregivers' agreement.

The baseline model is as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j} (\text{Member ID}) + r_{ij}$$

The outcome variable (Y_{ij}) is the report of pain behaviors i in dyad j (i refers to the 4 parallel scales per couple). Member ID was coded -.5 for caregivers and .5 for patients. β_{0j} is the model intercept and represents the mean of pain behaviors when the predictor (Member ID) is held constant (i.e., 0, which is the couple average). The β_{1j} is the slope and it indicates the caregivers' and patients' agreement in dyad j .

In the level 2 model, caregivers' attentional bias to pain and the square of caregivers' attentional bias to pain were added as explanatory variables to examine the variation across dyads in the mean score of pain behaviors (β_{0j}) and to study the association of these explanatory variables in the agreement between patients and caregivers in reporting pain behaviors (β_{1j}). In addition, the patients' report of pain severity was added to the level 2 model as a control variable.

The level 2 equations are as follow:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{patients' report of pain severity}) + \gamma_{02}(\text{attentional bias to pain}) + \gamma_{03}(\text{square of attentional bias to pain}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{patients' report of pain severity}) + \gamma_{12}(\text{attentional bias to pain}) + \gamma_{13}(\text{square of attentional bias to pain}) + u_{1j}$$

In these equations, γ_{01} represents the effect of patients' report of pain severity on the dyads' mean report of pain behaviors, γ_{02} represents the linear influence of caregivers' attentional bias on the dyads' mean report of pain behaviors, γ_{03} represents the curvilinear relationship between caregivers' attentional bias to pain and the dyads' mean report of pain behaviors and γ_{11} indicates the effect of patients' report of pain severity on the dyads' agreement on pain behaviors and γ_{12} indicates the linear impact of caregivers' attentional bias on the dyads' agreement on pain behaviors and γ_{13} indicates the curvilinear influence of caregivers' attentional bias on the dyads' agreement on pain behaviors.

Results

Sample characteristics

The sample consisted of 96 caregivers who accompanied a patient with chronic pain to the hospital, and 94 chronic pain patients (2 patients withdrew from the study). The mean age of caregivers was 38.44 (SD = 14.60) and the education level was 13.37 years (SD = 3.19). About half of the caregivers were male ($n = 49$; 51%) and the majority was married ($n = 63$; 65.6%). The mean age of patients was 46.39 (SD = 13.27) and the average years of education was 11.87 years (SD = 3.19). The majority of patients were female ($n = 74$; 78.7%) and married ($n = 79$; 84%). The average score of patients pain severity was 49.78 (SD = 29.79) and the average score for patient' disability level was 10.65 (SD = 5.75). Furthermore, the pain locations were distributed as follows: 23.9% lower and 17.4% upper limbs; 10.9% back pain, and 47.8% reported musculoskeletal pain in more than one location.

Forty dyads were couples (wife as patient: 31.6%; husband as patient: 10.5%), 28 dyads were mothers and daughters (mother as patients: 23.2%; daughter as patient: 6.3%). Eleven female patients reported their sons as the family caregivers (11.6%), and in 9 dyads one of the siblings was the caregiver (9.6%). Finally, 5 male patients indicated that their son (5.3%) and 2 male patients indicated that their daughter (2.1%) were the main family caregivers.

The forty-two control participants were statistically similar to the caregivers in age ($M = 39.57$; $SD = 9.65$) and education level ($M = 14.90$ years; $SD = 3.39$). The number of male participants ($N = 11$; 26%) was lower than the number of female participants ($N = 31$; 74%). Similar to the caregiver group, the majority of control participants were married ($N = 30$; 71.4%).

Preliminary analyses

The caregiver and control groups differed significantly only regarding to gender ($\chi^2 = 7.34$; $p = .007$). The correlation analyses showed no significant association between gender and type of trial (e.g., pain congruent, happy congruent) in the caregivers group nor in the control participants group, except for the correlation between gender and pain incongruent trials in the control participants group ($r = -.32$; $p = .03$). Although gender was only significantly correlated with incongruent trials in the control participants group, cautiously, we controlled for gender in the relevant analyses. This adjustment did not affect the results and, therefore, we decided not to include gender as a covariate in further analyses.

Attentional bias analyses (hypothesis 1 and 2).

A mixed model of 2 (Group: Caregiver vs. Control) \times 2 (Stimuli: Pain vs. Happy) \times 2 (Congruency: Congruent vs. Incongruent) was calculated. The results of ANOVA showed no main effects for Group, $F(1, 136) = 1.97$, $p = .162$, Stimuli, $F(1, 136) = 3.80$, $p = .053$, and Congruency, $F(1, 136) = .019$, $p = .89$. Two-way interactions were also not significant ($ps > .05$). Of particular interest, the three-way interaction between Group, Stimuli and Congruency reached a significant level, $F(1, 136) = 8.71$, $p = 0.004$, meaning that caregivers and controls show differences in their attention to pain and happy faces in congruent and incongruent trials. Figure 2 presents the mean reaction times for pain and happy congruent and incongruent trials, for both caregivers and control participants.

To examine whether the significant three-way interaction is in line with hypotheses 1 and 2, additional ANOVAs were performed for pain and happy stimuli, separately. For pain stimuli, the results showed no main effects for Group, $F(1, 136) = 2.32$, $p = .129$, and Congruency, $F(1, 136) = .03$, $p = .86$. The expected two-way interaction between Group and Congruency (hypothesis 1) was only approaching significance, $F(1, 136) = 3.86$, $p = .051$, and paired sample t-tests showed no significant differences in reaction time comparing pain congruent to pain incongruent trials in the caregiver group, $t = -1.49$, $p = .13$, nor in the control group, $t = 1.69$, $p = .098$. Although the difference between pain congruent and pain incongruent trials tended to be in the opposite direction for caregivers and control

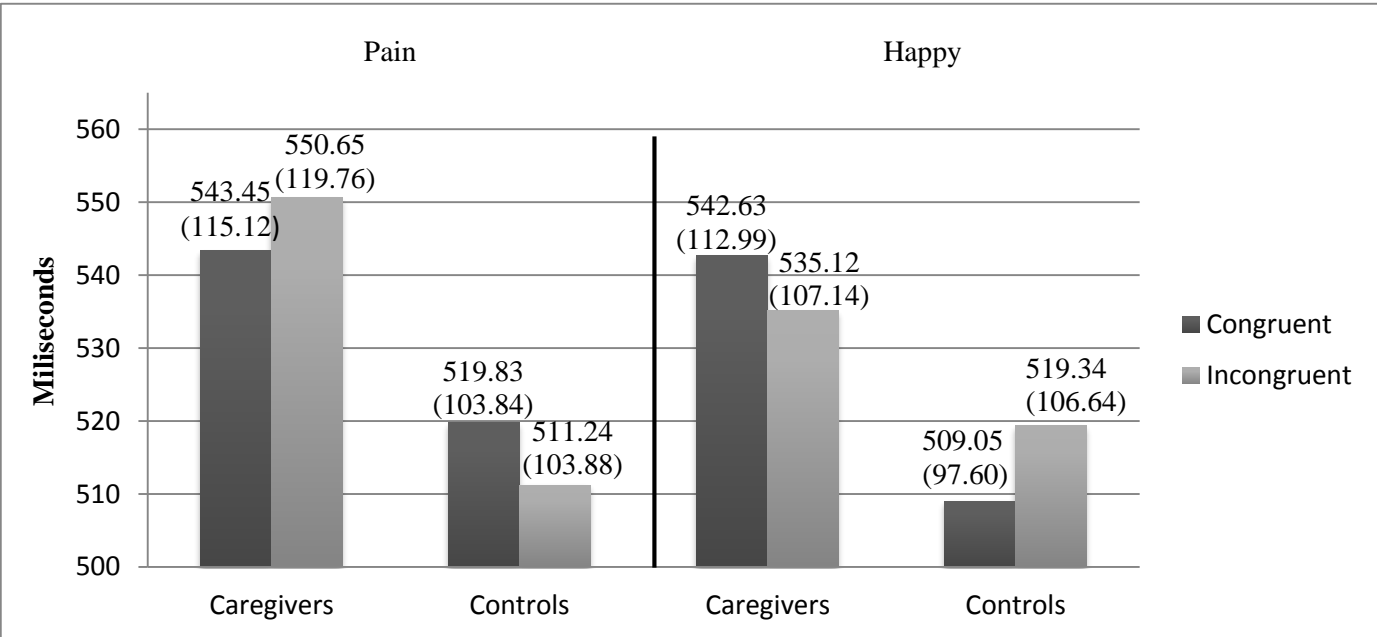


Figure 2. The mean reaction times (SDs) for pain and happy congruent and incongruent trials, for caregivers and control participants

participants, in contrast to hypothesis 1, caregivers did not respond faster to congruent than to incongruent pain trials.

For happy stimuli, the results also showed no main effects for Group, $F(1, 136) = 1.58$, $p = .21$ and Congruency, $F(1, 136) = .15$, $p = .69$. Although the two-way interaction between Group and Congruency was significant, $F(1, 136) = 6.16$, $p = .014$, paired sample t-tests showed no significant differences in responding to happy congruent and to happy incongruent trials neither in the caregiver group, $t = 1.88$, $p = .063$, nor in the control group, $t = -1.75$, $p = .086$.

To examine the three-way interaction from a different perspective, another series of ANOVAs were performed for the caregiver and control group, separately. Again no main effects were significant ($ps > .05$), but the two-way interaction between Stimuli and Congruency was significant for caregivers, $F(1, 95) = 4.42$, $p = .038$, as well as control participants, $F(1, 41) = 8.97$, $p = .005$. Paired sample t-tests showed that caregivers were slower in pain incongruent trials compared to happy incongruent trials, $t = -2.85$, $p = .005$, whereas there was no difference between pain and happy congruent trials among caregivers, $t = -.23$, $p = .816$. In contrast, participants in the control group showed faster reaction times in happy congruent trials than in pain congruent trials, $t = -2.64$, $p = 0.012$, while they showed no significant difference in response time to happy incongruent and pain incongruent trials, $t = 1.85$, $p = 0.071$. To summarize the findings for caregivers and control participants, we calculated attentional bias indices. Showing some support for hypothesis 2, the indices illustrate more attention toward pain faces ($\bar{x} = 7.19$, $SD = 47.21$) than happy faces ($\bar{x} = -7.5$, $SD = 39.08$) in caregivers. In contrast, control participants showed more attention toward happy faces ($\bar{x} = 10.29$, $SD = 37.94$) than pain faces ($\bar{x} = -8.58$, $SD = 32.89$).

Caregivers who score high on attentional bias toward pain report higher levels of pain behavior of patients than caregivers who score low on attentional bias (hypothesis 3).

The correlational analyses showed no significant associations between demographic variables and caregivers' attentional bias to pain (index) and their report of pain behaviors, but a significant positive correlation was observed between caregivers' attentional bias to pain and patients' report of pain severity ($r = .23$, $p = .028$). As hypothesized, caregivers who showed more attentional bias to pain also reported more pain behaviors in patients, $r = .28$, $p = .006$. Importantly, this association remained significant ($b = .13$, $p = .021$), while controlling for patients' pain severity ($b = .23$, $p = .001$).

Relatively high and low levels of attentional bias toward pain in caregivers are associated with less agreement between reports of patients' pain behavior within patient-caregiver dyads (hypothesis 4).

The results of the baseline model indicated that the mean report of pain behaviors across dyads was 18.36 ($p < .0001$). The dyads' agreement score of .22 did not reach a significant level ($p = .790$), which means that dyad members did not show significant differences in reporting pain behaviors. However, the significant random effects for both dyads' mean report of pain behaviors (u_0) and dyads' agreement (u_1) demonstrate that the variation between dyads is considerable and needs further investigation. Therefore, the level 2 model could be explored by adding additional variables to the model.

Patients' report of pain severity, caregivers' attentional bias to pain and the square of caregivers' attentional bias to pain were added as predictors at level 2 of the model. In addition, patients' report of pain severity was added to the model as a control variable. The results showed a significant association between patients' report of pain severity and dyads' report of pain behaviors ($p = .0001$). As well, the results indicated a significant linear association between caregivers' attentional bias to pain and the dyads' report of pain behaviors, meaning that higher levels of attentional bias toward pain in caregivers were associated with higher reports of pain behaviors of patients ($p = .031$). No significant association was found between the square of attentional bias to pain and the report of pain behaviors. In addition, patients' report of pain severity, caregivers' attentional bias and the square of caregivers' attentional bias to pain were not significantly associated with agreement in reports of pain behaviors between caregivers and patients. Similar to the baseline model, the random effects remained significant, indicating that other variables that were not taken into account in this study could influence the mean report of pain behaviors and the agreement in reports of pain behaviors within dyads. Table 1 presents the results of both the baseline and level 2 models.

Table 1. Baseline and level 2 hierarchical linear model for pain behaviors' report

Fixed effects	Baseline Model					Level 2 Model				
	B	SE	Df	T	p-value	β	SE	df	t	p-value
Dyad mean (β_0)										
Intercept (γ_{00})	18.36	.87	89	21.10	.0001	18.58	.81	86	22.85	.0001
Patients' report of pain severity (γ_{01})						.10	.02	86	3.82	.0001
Caregivers' attentional bias to pain (γ_{02})						.05	.02	86	2.19	.031
Square of Caregivers' attentional bias to pain (γ_{03})						-.00004	.00002	86	-.18	.851
Dyad agreement (β_1)										
Intercept (γ_{10})	.22	.87	89	.25	.79	-.16	.96	86	-.17	.862
Patients' report of pain severity (γ_{11})						-.01	.03	86	-.35	.722
Caregivers' attentional bias to pain (γ_{12})						-.003	.02	86	-.14	.884
Square of Caregivers' attentional bias to pain (γ_{13})						-.0003	.0004	86	-.79	.427
Random effects	Variance component		χ^2		p-value	Variance component		χ^2		p-value
u_0	59.23		693.87		.0001	47.04		543.45		.0001
u_1	32.97		169.70		.0001	34.94		168.06		.0001

Discussion

This study aims to expand our knowledge about caregivers' attentional bias to pain. The findings showed that neither caregivers nor controls responded significantly faster to pain congruent than to pain incongruent trials. Although, the difference in response time to pain congruent and pain incongruent trials tended to be in opposite directions for caregivers and control participants, overall these findings indicated no attentional bias toward pain and thus do not support hypothesis 1. However, caregivers were found to show more attention toward pain faces than happy faces, whereas control participants showed more attention toward happy faces than pain faces, providing some support for hypothesis 2. Furthermore, caregivers who showed relatively high levels of attentional bias toward pain reported more behavioral pain cues in patients than caregivers who showed relatively low levels of bias, above and beyond patients' pain severity. This finding is in support of hypothesis 3. Finally, in contrast to hypothesis 4, relatively high and low levels of attentional bias to pain cues among caregivers were not related to more disagreement between patients' and caregivers' reports of pain behaviors.

The existence of attentional bias to pain has been shown among family caregivers of patients with chronic pain (Mohammadi et al., 2012) and parents of children with pain (Liossi et al., 2012; Vervoort et al., 2011). In demonstrating attentional biases to pain information, one of the substantial elements is the nature of the stimuli. It is assumed that applying more

salient (Dear et al., 2011; Khatibi et al., 2009) and ecologically valid stimuli (Lautenbacher et al., 2013), such as painful faces compared to pain verbal stimuli (i.e., pain words), increase the likelihood of observing attentional bias. Therefore, the previous studies on attentional bias among patients with chronic pain (Khatibi et al., 2009) and among caregivers and parents (Liossi et al., 2012; Mohammadi et al., 2012; Vervoort et al., 2011) as well as the present study have used facial pain expressions. Although, this study revealed that caregivers showed more attention toward pain faces (pain index = 7.19) compared with happy faces (happy index = -7.50), it failed to show that caregivers are faster in responding to pain congruent than to pain incongruent trials. Therefore, caution is needed when interpreting the current findings and more research is needed to determine the existence of attentional bias to pain faces among family caregivers of patients with chronic pain.

The results do show an association between attentional bias and caregivers' detection of pain behaviors. This finding is important because caregivers rely on the detection of pain behaviors, such as facial expressions and body gestures, to infer pain and illness (LeResche & Dworkin, 1988; Lynch-Jordan, Kashikar-Zuck, & Goldschneider, 2010). Caregivers' accurate detection of patients' pain cues has been found to be associated with better well-being (Cremeans-Smith et al., 2003), less psychological problems (Sterba et al., 2008) and higher quality of life in patients (Miaskowski, Zimmer, Barrett, Dibble, & Wallhagen, 1997). Similarly, in a non-pain sample, caregivers' misreading illness has been linked to the patients' sense of caregivers' misunderstanding, perceived negligence, feelings of anger, and distancing (Prkachin, Solomon, & Ross, 2007).

The findings of this study suggest that highly attentive caregivers may have a better chance of detecting patients' pain behaviors—even when the effect of patients' reports of pain severity was controlled—and thus providing adequate support for their patients. However one might suggest that some patients in pain may conceal their pain behaviors, to avoid negative consequences (A. C. d. C. Williams, 2002; Zeman & Garber, 1996). A. C. d. C. Williams (2002) indicated that patients might conceal their pain to protect themselves from negative responses. In the same vein, Zeman and Garber (1996) showed that children may try to conceal their pain in front of peers because of a fear of negative reactions of their peers. Interestingly, some patients may conceal their concerns to protect their partners and caregivers from burden (Manne et al., 2007). Hence, anticipating negative consequences from the social network or trying to decrease the burden on caregivers may result in lower expression of pain and illness. Therefore, some highly attentive caregivers might not be able to find pain behaviors because their patients conceal their pain.

Although caregivers' attentional bias may enhance the detection of pain behaviors, we were concerned that it might increase the possibility of an inaccurate detection of the pain behaviors. As suggested by previous studies, attentional bias to pain information in caregivers might result in disagreement between patients' and caregivers' reports of pain intensity (Mohammadi et al., 2012) and might be associated with perceiving neutral information as painful cues (Liossi et al., 2012). However, this study did not confirm this concern. In contrast to earlier findings (Mohammadi et al., 2012), caregivers' attentional bias was not significantly

related –not linearly neither curvilinearly– to disagreement between caregivers and patients in reporting pain behaviors. Furthermore, pain severity as indicated by the patient was not associated with more or less disagreement between caregivers' and patients' reports of pain behavior. The differences between our results and previous findings might be caused by the different statistical methods that were applied. In a previous study (Mohammadi et al., 2012), patients and caregivers were categorized into congruent and incongruent dyads based on their estimation of pain intensity. Classifying patients and caregivers into groups and using the difference scores results in loss of statistical power (Cano et al., 2005). In the current study, we tried to overcome this problem and used patients' and caregivers' scores simultaneously in multilevel linear models. In addition, multilevel linear modeling is a more reliable technique for studying dyads, because patients and their caregivers cannot simply be considered as two independent participants (Kenny, Kashy, & Cook, 2006). Multilevel modeling controls the nonindependence and reduces the type I error by estimating both dyads means and the disagreement between dyads (Cano et al., 2005). Hence, based on the present findings it can be concluded that caregivers' attentional bias does not induce exaggerated and mistaken perceptions about patients' pain behaviors, and it does not appear to be a maladaptive phenomenon. However, this is the first study that has tried to explore the role of attentional bias in detecting patients' pain behaviors. So replication of these findings with other groups of caregivers is necessary to enable the generalization of our findings.

Furthermore, the current study has some limitations. First, we cannot draw the conclusion that caregivers who score higher on attentional bias are *better* at detecting pain behavior. The actual frequency of pain behaviors that patients displayed in our study is unknown. We only included patients' and caregivers' *perceptions* about pain behaviors, and it is possible that both reports about pain behaviors are biased and affected by their personal characteristics. In addition, it is conceivable that caregivers of patients who show more (or more intense) pain behaviors develop more attentional bias. Future research may need to ask caregivers to rate the pain behaviors of the same patients (e.g., by showing videotaped patients), thereby keeping the actual behaviors constant across caregivers. One might argue that caregivers high in attentional bias are better able to detect pain cues, if they report more pain behaviors than do caregivers low in attentional bias when pain behaviors are really subtle, but not when they are quite clear.

Second, in the present study, any caregiver who considered themselves as the main caregiver was asked to participate, regardless of the time that they spent with the patients. It is possible that caregivers who spend more hours with the patient are more aware of the patients' pain expressions than caregivers who spend fewer hours with a patient (Eritz & Hadjistavropoulos, 2011). The intensity or number of hours of caregiving per week should be considered as a confounding factor in future studies.

Third, our sample consisted of three main categories of dyads (i.e., spouses, parent-child and siblings) and each category could be divided to different subcategories. For instance, the spouse category consisted of dyads where the wife was the patient and others where the husband was the patient. It might be that the nature of the relationship influences

the level of attentional bias and its association with detecting pain information. However, considering the limited number of participants in each subcategory, we could not conduct these analyses. Furthermore, in the current study, the number of control participants was lower than the number of caregivers. Future studies may benefit from repeating the analyses on equal sample sizes of caregivers and controls. Finally, the current study did not include neutral-neutral trials. Hence it is not possible to determine that the observed reaction time to pain and happy stimuli is due to faster engagement (i.e., hypervigilance) or difficulty in disengaging from that stimulus.

Despite these limitations, the results of the present study add to our understanding of the role of attentional bias in detecting pain information. As expected, caregivers who showed higher levels of attentional bias do seem to detect more pain behaviors in patients. More importantly, our results also revealed that caregivers' attentional bias is not associated with disagreement on patients' pain behaviors within dyads, suggesting that attentional bias in caregivers does not induce an inaccurate detection of pain behavior.

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